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1980 PESTICIDE USE ON SOYBEANS
IN THE MISSISSIPPI VALLEY,

by

Michael Hanthorn, Craig Osteen,
Robert McDowell, and Larry Roberson

January 1982

ERS Staff Report No. AGES820127

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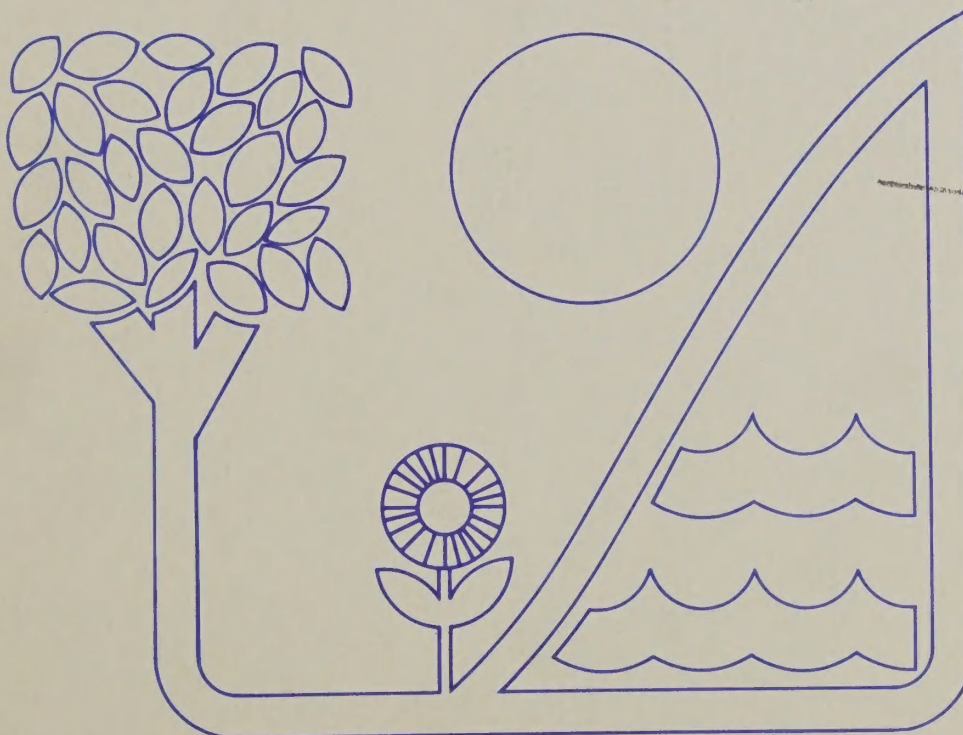
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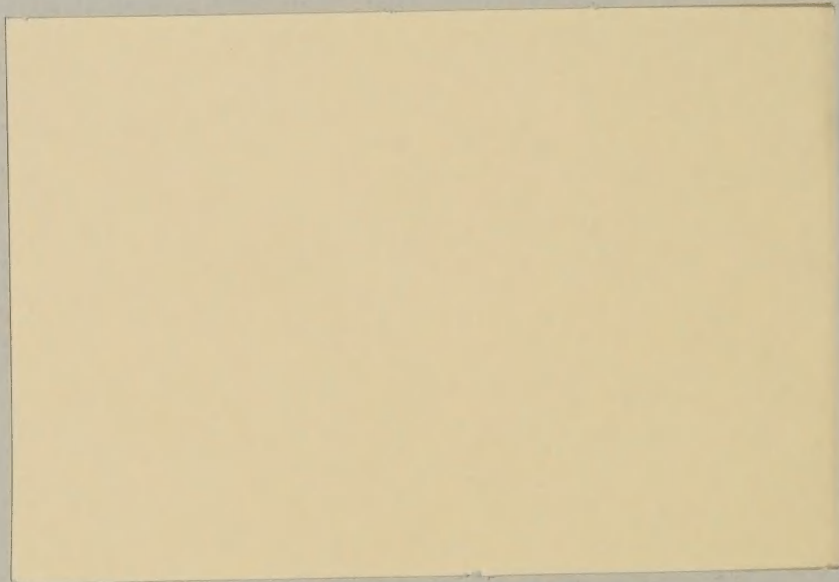
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Natural Resource Economics Division
Economic Research Service
U.S. Department of Agriculture
Washington, D.C. 20250

1980 PESTICIDE USE ON SOYBEANS IN THE MISSISSIPPI VALLEY. By Michael Hanthorn, Craig Osteen, Robert McDowell, and Larry Roberson; Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C. 20250; January 1982.

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ABSTRACT

Farmers reported that 28.5 million pounds (a.i.) of pesticides were applied to soybeans in the Mississippi Valley during 1980. This consisted of 26 million pounds (a.i.) of herbicides, 2.3 million pounds (a.i.) of insecticides, 51,000 pounds (a.i.) of nematocides, and 201,000 pounds (a.i.) of fungicides. Pesticide acre-treatments totaled 31.9 million and consisted of 28.4 million with herbicides, 2.8 million with insecticides, 68,000 with nematocides, and 721,000 with fungicides. The primary herbicides were alachlor, bentazon, metribuzin, and trifluralin. The major insecticides were carbaryl, methomyl, and methyl parathion. Benomyl was the primary fungicide. Herbicides were applied primarily to control cocklebur, crabgrass, and Johnsongrass infestations. Most insecticides were used for armyworm, cabbage looper, corn earworm, and velvetbean caterpillar control. Fungicides were mainly applied to control brown spot, leaf blight, and pod and stem blight. Coefficients of variation were computed for acres of soybeans treated with specific pesticides.

Key words: Pesticides, herbicides, insecticides, nematocides, fungicides, active ingredient, acres treated, acre-treatments, application rates, primary target pests, soybeans, and Mississippi Valley.

* * * * *

* This paper was prepared for limited distribution to the research community outside the U.S. Department of Agriculture. Use of product names in this report is for identification only, and does not imply endorsement by the U.S. Department of Agriculture. *

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AUTHORS

Hanthorn, Osteen, and McDowell are with the Economic Research Service. Roberson is with the Statistical Reporting Service.

PREFACE

This report presents data for pesticides applied to soybeans in the Mississippi Valley during 1980. Pesticide use data for the major producing States not included in the Mississippi Valley and for all major producing regions are available in the following ERS Staff Reports:

- "1980 Pesticide Use on Soybeans in the North Central States"
- "1980 Pesticide Use on Soybeans in the Southeast"
- "1980 Pesticide Use on Soybeans in the Major Producing States".

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INTRODUCTION

This report presents pesticide use data for soybeans grown in the Mississippi Valley during 1980. The data include usage patterns and quantities of specific herbicides, insecticides, nematocides, and fungicides applied to soybeans. This information should be useful to policymakers, academic institutions, government agencies, and private and commercial entities in evaluating the impacts of regulatory actions on specific pesticides, conducting economic analyses of pesticide use, developing more effective pest management programs, and conducting pesticide market analyses.

METHODOLOGY AND TERMINOLOGY

The Economics and Statistics Service collected pesticide use data as part of the 1980 Soybean Objective Yield Survey. A total of 1,915 farmers, of which 560 were located in the Mississippi Valley, were personally interviewed by enumerators in the 17 major soybean producing States. The sample size by State was as follows: Arkansas, 150; Kentucky, 90; Louisiana, 100; Mississippi, 130; and Tennessee, 90.

Sample fields for each State were randomly selected from farmers who reported through the June Enumerative Survey that they had planted or intended to plant soybeans in 1980. Each soybean acre in a State had an equal probability of being selected. Consequently, the probability of a field being chosen was directly correlated to its size.

Several terms pertinent to this report are defined as follows. An "active ingredient" (a.i.) is that portion of a pesticide material that provides the control activity. "Acres treated" are the number of acres receiving one or more applications of a specific pesticide during the growing season. Acres treated with different pesticide materials cannot be summed because more than one

material may have been applied on a given acre during the growing season. Therefore, the addition of these numbers would result in multiple counting. "Acre-treatments" are the number of acres treated with a pesticide material multiplied by the number of applications made during the growing season. Acre-treatments are summed for each material at the State and regional level. "Pesticide mixes" are two or more pesticide materials that are premixed during formulation or tank-mixed at the time of application.

Pesticide application rates vary as a result of weather conditions, soil type, weed spectrum, insect species, and disease type. Also, the method of application influences the amount of a material used per acre. Herbicide and foliar insecticide application rates are generally expressed as broadcast rates. The amount of a material applied on an acre in either a band, in-furrow, or spot application is generally one-fourth to one-third the amount applied in a broadcast application. The application rate listed for each material in this report is an aggregation of band, broadcast, in-furrow, and spot applications.

RELIABILITY OF ESTIMATES

Estimates based upon sample surveys have varying degrees of statistical reliability. Confidence in data depends upon sample size, sampling methods, and the variability of the responses. To provide the user of the data with some indication of the reliability of the estimates, coefficients of variation (CV's) are presented in Appendix Table 1. The CV is a measure of relative variation (expressed in percentage terms) and can be used to indicate the degree of confidence a user can place in the estimate. The smaller the CV, the more reliable the estimate.

In simplest terms, it can be said there is 95 percent confidence that the sample represents the true population and that the true value for the population

lies within an interval defined as the estimated value ± 2 CV's times the estimated value. For example, with a CV of 10 percent and an estimate of 40, the interval would be 32 to 48. However, there is also a 5 percent chance that the true value does not fall within the interval as defined above because the sample is not representative of the population.

CV's were calculated only for acres treated with specific pesticides. The estimates of acres treated are expected to have greater variation than other data reported. Consequently, for most other information included in this report, the level of reliability should be equal to or greater than reported for acres treated.

MISSISSIPPI VALLEY

Description

The Mississippi Valley includes Arkansas, Kentucky, Louisiana, Mississippi, and Tennessee (Figure 1). In 1980, approximately one-fourth of the U.S. soybean acreage (16.6 million acres) was planted in this region, from which 16 percent of the national crop (287 million bushels) was produced (Table 1). The farm value of soybeans grown in this region during 1980 was \$2.3 billion.

Trends in Pesticide Use

There was a substantial increase in the amount of acreage planted to soybeans and treated with pesticides in the Mississippi Valley between 1972 and 1980. Acres planted increased more than one-half from 10.8 to 16.6 million, while acres treated with herbicides and insecticides increased 8.8 and 2.3 million, respectively (Table 2). About 91 percent of the planted acres were treated with herbicides in 1980, which amounted to a 135 percent increase between 1972 and 1980. About 15 percent of the planted acres were treated with insecticides in 1980, which represented a tenfold increase in insecticide

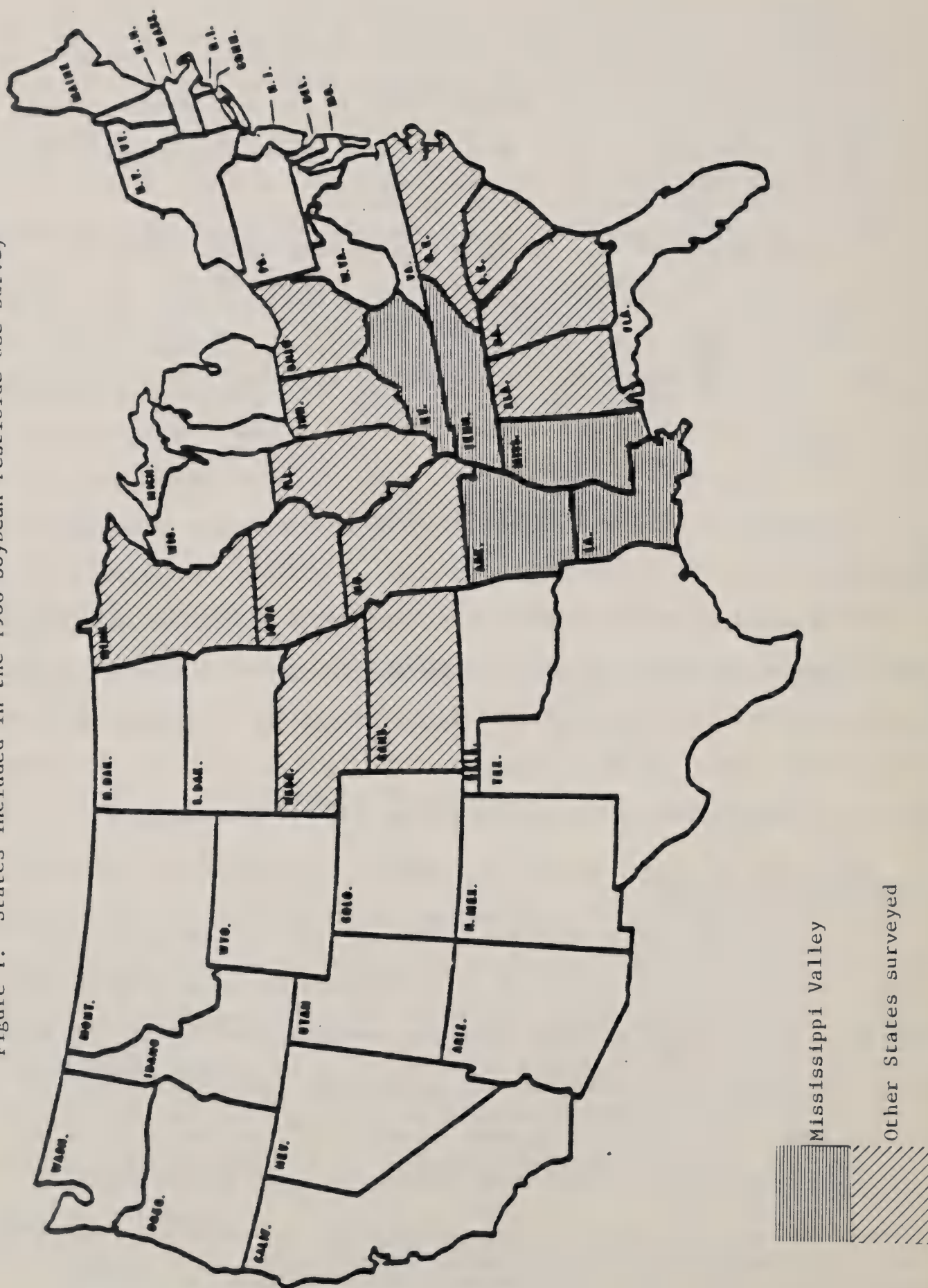


Table 1. Soybean acreage planted and harvested, production, and value in the Mississippi Valley, 1980

States	: Total acres a/ :		: Total : Total	
	: Planted :	Harvested :	production a/ :	value b/
	----- Million -----		Million bushels	Million dollars
Arkansas	4.8	4.4	70	560
Kentucky	1.6	1.6	37	283
Louisiana	3.5	3.4	70	556
Mississippi	4.0	3.8	62	477
Tennessee	2.7	2.5	48	388
Region	16.6	15.7	287	2,264
U.S. Total	70.1	67.9	1,817	13,825
Percent of U.S. Total	24	23	16	16

a/ "Crop Production-1980 Annual Summary", USDA, ESS, Crop Reporting Board, CrPr 2-1(81), January 14, 1981.

b/ "Field Crops-Production, Disposition, Value 1979-80", USDA, ESS, Crop Reporting Board, CrPr 1(81), April 1981.

Table 2. Soybean acreage planted and treated for weed, insect, nematode, and disease control in the Mississippi Valley, 1972 and 1980

States	Planted		Treated acres a/				Percent of planted acres treated			
	acres		Herbicides		Insecticides		Herbicides		Insecticides	
	1972 b/	1980 c/	1972 d/	1980 e/	1972 d/	1980 e/	1972:	1980:	1972:	1980
	----- Million -----		-----Thousand-----				----- Percent -----			
Arkansas	4.1	4.8	2.8	4.2	97	280	69	88	2	6
Kentucky	1.0	1.6	f/	1.6	f/	88	f/	97	f/	5
Louisiana	1.7	3.5	1.0	3.0	128	1,265	56	86	7	37
Mississippi	2.6	4.0	1.7	3.8	34	773	67	96	1	19
Tennessee	1.4	2.7	.8	2.5	-	130	58	94	-	5
Region	10.8	16.6	6.3	15.1	259	2,536	64 g/	91	3 g/	15

- None reported.

a/ Nematicide and fungicide use was not reported in these States in 1972. In 1980, the number of planted acres treated with nematicides in these States was as follows: Arkansas, 35,000, and Tennessee, 33,000. Fungicide treated acres were as follows: Arkansas, 70,000; Kentucky, none reported; Louisiana, 268,000; Mississippi, 207,000; and Tennessee, 65,000.

b/ "Agricultural Statistics, 1974", U.S. Department of Agriculture.

c/ "Crop Production-1980 Annual Summary", USDA, ESS, Crop Reporting Board, CrPr 2-1(81), January 14, 1981.

d/ Herman W. Delvo, "1972 Soybean Objective Yield Survey", USDA, ERS, Farm Production Economics Division, 1972, (unpublished).

e/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

f/ Not surveyed in 1972.

g/ Computed excluding planted acres for Kentucky.

treated acres during this period. Less than 1 percent (68,000) of the planted acres were treated with nematicides in 1980. Fungicide treated acres totaled 610,000, or 4 percent of the planted acres in 1980.

Pesticide Use

The major soybean weed, insect, and disease pests, as reported by farmers in the Mississippi Valley, are listed in Tables 3, 4, and 5, respectively. Although several pests may have been present at any given time and caused varying degrees of damage, farmers were asked to report what they perceived to be the primary target pest for each material applied to soybeans. In 1980, cocklebur was the primary target pest for 33 percent of the herbicide acre-treatments, Johnsongrass for 21 percent, and crabgrass for 17 percent (Table 3). Insecticide acre-treatments were primarily made to control armyworm (32 percent), cabbage looper (10 percent), corn earworm (16 percent), and velvetbean caterpillar (11 percent) infestations (Table 4). About 42 percent of the fungicide acre-treatments were made to control pod and stem blight and 38 percent were made to control brown spot and leaf blight (Table 5).

Approximately 28.5 million pounds (a.i.) of pesticides were applied to soybeans in 1980 (Table 6). Of these, 22 million pounds (a.i.) were single material herbicides, 4 million pounds (a.i.) were herbicide mixes, 1.3 million pounds (a.i.) were single material insecticides, 1 million pounds (a.i.) were insecticide mixes, 51,000 pounds (a.i.) were nematicides, and 201,000 pounds (a.i.) were fungicides. Application rates for herbicides, applied alone and in mixes, were 0.9 and 1.4 pounds (a.i.) per acre-treatment, respectively. Insecticide application rates averaged 0.6 pound (a.i.) per acre-treatment for single materials and 1.6 pounds (a.i.) per acre-treatment for mixes. Nematicide and fungicide rates averaged 0.8 and 0.3 pound (a.i.) per acre-treatment, respectively.

Table 3. Percentage of soybean herbicide acre-treatments by primary weeds controlled as reported by farmers in the Mississippi Valley, 1980 a/

Weeds	: :Arkansas	: :Kentucky	:Louisiana	:Mississippi	:Tennessee	: :Region
	----- Percent -----					
<u>Grasses</u>						
Barnyardgrass	5	1	5	-	-	2
Broadleaf signalgrass	5	-	6	2	-	3
Crabgrass	22	6	16	16	18	17
Foxtail	2	18	-	-	1	3
Johnsongrass	17	26	22	21	23	21
Other	8	8	10	3	3	6
<u>Broadleaf weeds</u>						
Cocklebur	33	28	19	33	47	33
Morningglory	6	5	4	11	2	6
Pigweed	-	2	7	4	3	3
Ragweed	1	5	-	1	2	1
Sicklepod	-	-	1	3	-	1
Other	1	1	10	6	1	4

- None reported.

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Table 4. Percentage of soybean insecticide acre-treatments by primary insects controlled as reported by farmers in the Mississippi Valley, 1980 a/

Insects	: :Arkansas	: :Kentucky	:Loui- :siana	:Missis- :sippi	: :Tennessee	: :Region
	<u>Percent</u>					
Armyworm	53	100	31	27	-	32
Bean leaf beetle	-	-	10	-	-	5
Cabbage looper	-	-	7	19	-	10
Corn earworm	21	-	2	31	75	16
Cutworm	-	-	5	8	-	5
Grasshopper	-	-	5	11	-	6
Threecornered alfalfa hopper	-	-	5	-	-	3
Velvetbean caterpillar	-	-	20	-	-	11
Other	26	-	15	4	25	12

- None reported.

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Table 5. Percentage of soybean fungicide acre-treatments by primary diseases controlled as reported by farmers in the Mississippi Valley, 1980 a/ b/

Diseases	:	:	:	:	:
	:Arkansas	:Louisiana	:Mississippi	:Tennessee	:Region
	<u>Percent</u>				
Anthracnose	-	-	14	-	5
Brown spot	50	-	14	100	19
Leaf blight	-	11	43	-	19
Leaf spot	-	-	15	-	5
Pod and stem blight	-	89	-	-	42
Root rot	50	-	14	-	10

- None reported.

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Fungicide use was not reported in Kentucky for 1980.

Table 6. Usage patterns and quantities of specific pesticides applied to soybeans in the Mississippi Valley, 1980 a/

Pesticides	: Acres <u>b/</u>	: Acre- <u>c/</u>	: Pounds of active ingredient	
	: treated	: treatments	: Total	: Per treatment
----- <u>Thousand</u> -----				
HERBICIDES				
<u>Single materials</u>				
Alachlor	2,142	2,142	4,857	2.3
Bentazon	5,186	5,526	3,503	.6
Fluchloralin	1,188	1,188	1,061	.9
Glyphosate	834	955	551	.6
Linuron	781	781	423	.5
Metribuzin	3,435	3,455	1,651	.5
Pendimethalin	879	879	920	1.0
Trifluralin	8,206	8,210	7,209	.9
Other	-	2,276	1,808	.8
Total	-	25,412	21,983	.9
<u>Tank-mix materials</u>				
Acifluorfen + bentazon	330	330	97+176	.3+ .5
Alachlor + metribuzin	255	255	537+97	2.1+ .4
Bentazon + 2,4-DB	288	288	155+24	.5+ .1
Dinoseb + naptalam	640	798	366+701	.5+ .9
Metribuzin + trifluralin	347	347	201+338	.6+1.0
Other	-	924	1,303	1.4
Total	-	2,942	3,995	1.4
Total herbicides	-	28,354	25,978	.9
INSECTICIDES				
<u>Single materials</u>				
Carbaryl	249	287	341	1.2
Methomyl	490	524	233	.4
Methyl parathion	533	725	451	.6
Other	-	574	259	.5
Total	-	2,110	1,284	.6
<u>Tank-mix materials</u>				
EPN + methyl parathion	211	283	207+207	.7+ .7
Methyl parathion + toxaphene	324	363	274+342	.8+ .9
Total	-	646	1,030	1.6
Total insecticides	-	2,756	2,314	.8

-- continued

Table 6. Usage patterns and quantities of specific pesticides applied to soybeans in the Mississippi Valley, 1980 a/ -- continued

Pesticides	: Acres <u>b/</u>	: Acre- <u>c/</u>	: Pounds of active ingredient	
	: treated	: treatments	: Total	: Per treatment
----- <u>Thousand</u> -----				
NEMATICIDES				
Total <u>d/</u>	-	68	51	.8
FUNGICIDES				
Benomyl	406	517	136	.3
Captan	68	68	40	.6
PCNB + etridiazole	102	102	7+2	.1+ .01
Other	-	34	16	.5
Total	-	721	201	.3
TOTAL PESTICIDES	-	31,899	28,544	.9

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides, insecticides, nematocides, and fungicides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Specific materials not reported because of a limited number of observations.

Farmers made 31.9 million pesticide acre-treatments, comprised of 25.4 million with single material herbicides, 2.9 million with herbicide mixes, 2.1 million with single material insecticides, 646,000 with insecticide mixes, 68,000 with nematicides, and 721,000 with fungicides.

Trifluralin acre-treatments totaled 8.2 million, or 32 percent of those made with single material herbicides. Also, this set of acre-treatments included 5.5 million (22 percent) with bentazon, 3.5 million (14 percent) with metribuzin, and 2.1 million (8 percent) with alachlor. About 798,000 (27 percent) of the herbicide mix acre-treatments were made with dinoseb plus naptalam. Approximately the same proportion of acre-treatments was made with four other herbicide mixes. These totaled 330,000 (11 percent) with acifluorfen plus bentazon, 255,000 (9 percent) with alachlor plus metribuzin, 288,000 (10 percent) with bentazon plus 2,4-DB, and 347,000 (12 percent) with metribuzin plus trifluralin.

One-fourth of the alachlor acre-treatments were made for crabgrass control, while one-half were made to control barnyardgrass, broadleaf signalgrass, cocklebur, foxtail, Johnsongrass, and pigweed infestations (Appendix Tables 2 and 3). Cocklebur control accounted for 92 percent of the bentazon acre-treatments and 35 percent of the metribuzin acre-treatments. Also, 13 percent of the metribuzin acre-treatments were made to control morningglory infestations. Trifluralin acre-treatments totaled 32 and 44 percent, respectively, for crabgrass and Johnsongrass control.

One-third (725,000) of the single material insecticide acre-treatments were methyl parathion and one-fourth (524,000) were methomyl (Table 6). Carbaryl acre-treatments totaled 287,000 (14 percent). About 363,000 (56 percent) of the insecticide mix acre-treatments were methyl parathion plus toxaphene, while 283,000 (44 percent) were EPN plus methyl parathion. Armyworm control accounted for 87 percent of the carbaryl, 36 percent of the methomyl, and 10 percent of

the methyl parathion acre-treatments (Appendix Table 4). Also, methomyl acre-treatments totaled 38 percent for corn earworm control and 13 percent for cabbage looper control. One-third of the methyl parathion acre-treatments were made to control velvetbean caterpillar infestations and 22 percent were made for cabbage looper and threecornered alfalfa hopper control.

Nematicide acre-treatments totaled 68,000 (Table 6). Benomyl accounted for 72 percent (517,000) of the fungicide acre-treatments, while captan and PCNB plus etridiazole acre-treatments comprised 24 percent (170,000). About 59 and 27 percent of the benomyl acre-treatments were made for pod and stem blight and leaf blight control, respectively (Appendix Table 5). Approximately one-half of the captan acre-treatments were made to control brown spot and the other half were made for root rot control. All of the PCNB plus etridiazole was used to control brown spot infestations.

ARKANSAS

In 1980, Arkansas farmers planted 4.8 million acres of soybeans, of which 4.2 million were treated with herbicides, 280,000 were treated with insecticides, 35,000 were treated with nematicides, and 70,000 were treated with fungicides (Table 2). Approximately 5.4 million pounds (a.i.) of pesticides were applied to soybeans, which constituted 4.8 million pounds of single material herbicides, 500,000 pounds of herbicide mixes, 102,000 pounds of insecticides, 18,000 pounds of nematicides, and 18,000 pounds of fungicides (Table 7). Application rates for herbicides, applied alone and in mixes, averaged 0.8 and 1.5 pounds (a.i.) per acre-treatment, respectively. Insecticide application rates averaged 0.8 pound (a.i.) per acre-treatment. Nematicide and fungicide rates averaged 0.5 and 0.3 pound (a.i.) per acre-treatment, respectively.

Pesticide acre-treatments totaled 6.9 million, comprised of 6.3 million

Table 7. Usage patterns and quantities of specific pesticides applied to soybeans in Arkansas, 1980 a/

Pesticides	: Acres <u>b/</u>	: Acre- <u>c/</u>	: Pounds of active ingredient	
	: treated	: treatments	: Total	: Per treatment
----- <u>Thousand</u> -----				
HERBICIDES				
<u>Single materials</u>				
Alachlor	341	341	477	1.4
Bentazon	1,755	1,825	1,149	.6
Fluchloralin	385	385	403	1.0
Metribuzin	346	346	147	.4
Pendimethalin	210	210	256	1.2
Trifluralin	2,542	2,542	1,929	.8
Other	-	687	421	.6
Total	-	6,336	4,782	.8
<u>Tank-mix materials</u>				
Dinoseb + naptalam	148	183	77+147	.4+ .8
Other	-	140	276	2.0
Total	-	323	500	1.5
Total herbicides	-	6,659	5,282	.8
INSECTICIDES				
Carbaryl	35	35	60	1.7
Methomyl	63	63	24	.4
Other	-	35	18	.5
Total	-	133	102	.8
NEMATICIDES				
Total <u>d/</u>	-	35	18	.5
FUNGICIDES				
Total <u>d/</u>	-	70	18	.3
TOTAL PESTICIDES	-	6,897	5,420	.8

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides, insecticides, nematocides, and fungicides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Specific materials not reported because of a limited number of observations.

with single material herbicides, 323,000 with herbicide mixes, 133,000 with insecticides, 35,000 with nematicides, and 70,000 with fungicides.

Bentazon and trifluralin accounted for 1.8 and 2.5 million (29 and 40 percent) of the single material herbicide acre-treatments. About 183,000 (57 percent) of the herbicide mix acre-treatments were dinoseb plus naptalam. Crabgrass control accounted for 41 percent of the alachlor acre-treatments, 19 percent of the metribuzin acre-treatments, and 37 percent of the trifluralin acre-treatments (Appendix Table 2). One-fifth of the alachlor acre-treatments were made to control foxtail infestations and one-third of the trifluralin acre-treatments were made for Johnsongrass control. Cocklebur control comprised 96 percent of the bentazon and 41 percent of the metribuzin acre-treatments (Appendix Table 3).

Methomyl totaled 63,000 (47 percent) of the insecticide acre-treatments, while carbaryl acre-treatments totaled 35,000 (26 percent) (Table 7). Armyworm was the primary target pest for all of the carbaryl and methyl parathion acre-treatments, and 44 percent of the methomyl acre-treatments were made to suppress corn earworm infestations (Appendix Table 4).

Nematicide and fungicide acre-treatments totaled 35,000 and 70,000, respectively (Table 7). Brown spot was the primary target disease for one-half of the fungicide acre-treatments and root rot for the other half (Table 5).

KENTUCKY

Acres planted to soybeans totaled 1.6 million in Kentucky during 1980 (Table 2). Virtually all of the acreage was treated with herbicides, while 88,000 acres were treated with insecticides. Nematicide and fungicide use was not reported in Kentucky for 1980. A total of 3.9 million pounds (a.i.) of pesticides were applied to soybeans, which consisted of 3.1 million pounds of

single material herbicides, 753,000 pounds of herbicide mixes, and 11,000 pounds of insecticides (Table 8). Herbicide application rates averaged 1.1 pounds (a.i.) per acre-treatment for single materials and 1.9 pounds (a.i.) per acre-treatment for mixes. The average application rate for insecticides was 0.5 pound (a.i.) per acre-treatment.

Pesticide acre-treatments totaled 3.3 million and consisted of 2.9 million with single material herbicides, 399,000 with herbicide mixes, and 22,000 with insecticides.

More than one-fifth (628,000) of the single material herbicide acre-treatments were trifluralin. Alachlor, bentazon, and metribuzin acre-treatments accounted for 1.3 million (46 percent). One-third (140,000) of the herbicide mix acre-treatments were dinoseb plus naptalam. Also, 66,000 (17 percent) of these acre-treatments were alachlor plus linuron, 53,000 (13 percent) were bentazon plus 2,4-DB, and 44,000 (11 percent) were metribuzin plus trifluralin.

The proportion of herbicide acre-treatments to control the primary weed pests was different in Kentucky than in the region as a whole. A larger proportion of herbicide acre-treatments was made to control foxtail infestations and a smaller proportion was made to control crabgrass infestations (Table 3). Alachlor acre-treatments totaled 20, 29, and 14 percent, respectively, for crabgrass, foxtail, and morningglory control (Appendix Tables 2 and 3). Bentazon acre-treatments totaled 69 percent for cocklebur control and 15 percent for ragweed control. One-half of the metribuzin acre-treatments were made to control cocklebur infestations and 15 percent were made for Johnsongrass control. Trifluralin acre-treatments totaled 46 percent for Johnsongrass control, 28 percent for foxtail control, and 12 percent for cocklebur control.

Insecticide acre-treatments totaled 22,000 (Table 8). All of the insecticides were used to suppress armyworm infestations (Table 4).

Table 8. Usage patterns and quantities of specific pesticides applied to soybeans in Kentucky, 1980 a/

Pesticides	: Acres <u>b/</u>	: Acre- <u>c/</u>	: Pounds of active ingredient	
	: treated	: treatments	: Total	: Per treatment
----- <u>Thousand</u> -----				
HERBICIDES				
<u>Single materials</u>				
Alachlor	450	450	1,019	2.3
Bentazon	431	431	403	.9
Glyphosate	226	290	299	1.0
Metribuzin	434	434	195	.4
Trifluralin	628	628	633	1.0
Other	-	632	585	.9
Total	-	2,865	3,134	1.1
<u>Tank-mix materials</u>				
Alachlor + linuron	66	66	108+39	1.6+ .6
Bentazon + 2,4-DB	53	53	32+6	.6+ .1
Dinoseb + naptalam	118	140	98+187	.7+1.4
Metribuzin + trifluralin	44	44	18+77	.4+1.8
Other	-	96	188	2.0
Total	-	399	753	1.9
Total herbicides	-	3,264	3,887	1.2
INSECTICIDES				
Total <u>d/</u>	-	22	11	.5
TOTAL PESTICIDES	-	3,286	3,898	1.2

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides and insecticides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Specific materials not reported because of a limited number of observations.

LOUISIANA

About 3.5 million acres of soybeans were planted in Louisiana during the 1980 growing season (Table 2). Of these, 3 million were treated with herbicides, 1.3 million were treated with insecticides, and 268,000 were treated with fungicides. A total of 7.7 million pounds (a.i.) of pesticides were applied to soybeans, consisting of 5.4 million pounds of single material herbicides, 905,000 pounds of herbicide mixes, 876,000 pounds of single material insecticides, 372,000 pounds of insecticide mixes, and 86,000 pounds of fungicides (Table 9). An estimated 1.2 pounds (a.i.) of single material herbicides and 1.8 pounds (a.i.) of herbicide mixes were applied per acre-treatment. The respective application rates for insecticides, applied alone and in mixes, were 0.7 and 1.2 pounds (a.i.) per acre-treatment. Fungicide rates averaged 0.3 pound (a.i.) per acre-treatment.

Pesticide acre-treatments totaled 6.8 million and consisted of 4.4 million with single material herbicides, 498,000 with herbicide mixes, 1.3 million with single material insecticides, 307,000 with insecticide mixes, and 345,000 with fungicides.

One-half (2.2 million) of the single material herbicide acre-treatments were either metribuzin or trifluralin. Alachlor acre-treatments totaled 843,000 (19 percent). About 192,000 (39 percent) of the herbicide mix acre-treatments were acifluorfen plus bentazon and 153,000 (31 percent) were alachlor plus metribuzin.

A lower proportion of herbicide acre-treatments was made for cocklebur control in Louisiana than in the other Mississippi Valley States (Table 3). Alachlor acre-treatments totaled 18 percent for barnyardgrass control, 14 percent for broadleaf signalgrass control, and 23 percent for crabgrass control (Appendix Table 2). Cocklebur control accounted for 82 percent of the bentazon

Table 9. Usage patterns and quantities of specific pesticides applied to soybeans in Louisiana, 1980 a/

Pesticides	: Acres b/ : Acre-		c/ : Pounds of active ingredient	
	: treated	: treatments	: Total	: Per treatment
----- Thousand -----				
HERBICIDES				
Single materials				
Alachlor	843	843	2,475	2.9
Bentazon	211	211	144	.7
Linuron	211	211	68	.3
Metribuzin	1,112	1,131	476	.4
Pendimethalin	288	288	379	1.3
Trifluralin	1,035	1,054	1,179	1.1
Other	-	690	719	1.0
Total	-	4,428	5,440	1.2
Tank-mix materials				
Acifluorfen + bentazon	192	192	55+115	.3+ .6
Alachlor + metribuzin	153	153	420+54	2.7+ .4
Other	-	153	261	1.7
Total	-	498	905	1.8
Total herbicides	-	4,926	6,345	1.3
INSECTICIDES				
Single materials				
Carbaryl	192	230	271	1.2
Malathion	77	153	81	.5
Methomyl	115	115	29	.3
Methyl parathion	498	690	433	.6
Other	-	77	62	.8
Total	-	1,265	876	.7
Tank-mix materials				
EPN + methyl parathion	38	77	14+14	.2+ .2
Methyl parathion + toxaphene	192	230	172+172	.8+ .8
Total	-	307	372	1.2
Total insecticides	-	1,572	1,248	.8
FUNGICIDES				
Benomyl	268	345	86	.3
TOTAL PESTICIDES	-	6,843	7,679	1.1

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides, insecticides, and fungicides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

acre-treatments (Appendix Table 3). About 30 percent of the metribuzin acre-treatments were made to control broadleaf signalgrass, crabgrass, and Johnsongrass infestations. Also, 22 percent were made for cocklebur control and 14 percent were made to control pigweed infestations. Six-tenths of the trifluralin acre-treatments were made for Johnsongrass control.

About 690,000 (55 percent) of the single material insecticide acre-treatments were methyl parathion, while 230,000 (18 percent) were carbaryl and 153,000 (12 percent) were malathion (Table 9). Three-fourths (230,000) of the insecticide mix acre-treatments were methyl parathion plus toxaphene and one-fourth (77,000) were EPN plus methyl parathion. All of the methomyl and 83 percent of the carbaryl acre-treatments were made to suppress armyworm infestations (Appendix Table 4). One-third of the methyl parathion acre-treatments were made to control velvetbean caterpillar infestations and 22 percent were made for cabbage looper and threecornered alfalfa hopper control.

Benomyl acre-treatments totaled 345,000 (Table 9). Pod and stem blight was the primary target disease for 89 percent of the benomyl acre-treatments and leaf blight for 11 percent (Appendix Table 5).

MISSISSIPPI

Farmers planted 4 million acres of soybeans in Mississippi during 1980 and treated 3.8 million acres with herbicides, 773,000 acres with insecticides, and 207,000 acres with fungicides (Table 2). Approximately 6.8 million pounds (a.i.) of pesticides were applied to soybeans, of which 5.1 million were single material herbicides, 914,000 were herbicide mixes, 287,000 were single material insecticides, 456,000 were insecticide mixes, and 68,000 were fungicides (Table 10). Herbicide application rates averaged 0.7 pound (a.i.) per acre-treatment for single materials and 0.9 pound (a.i.) per acre-treatment for mixes. Application

Table 10. Usage patterns and quantities of specific pesticides applied to soybeans in Mississippi, 1980 a/

Pesticides	: Acres <u>b/</u> : Acre- <u>c/</u> : Pounds of active ingredient			
	: treated	: treatments	: Total	: Per treatment
----- Thousand -----				
HERBICIDES				
<u>Single materials</u>				
Alachlor	345	345	494	1.4
Bentazon	1,351	1,537	775	.5
Fluchloralin	379	379	250	.7
Metribuzin	1,413	1,413	738	.5
Pendimethalin	348	348	252	.7
Trifluralin	2,550	2,519	2,167	.9
Other	-	758	435	.6
Total	-	7,299	5,111	.7
<u>Tank-mix materials</u>				
Acifluorfen + bentazon	103	103	29+34	.3+ .3
Dinoseb + diphenamid	69	103	25+33	.2+ .3
Dinoseb + naptalam	210	279	90+172	.3+ .6
Linuron + 2,4-DB	103	103	29+5	.3+ .05
Metribuzin + trifluralin	172	172	93+146	.5+ .9
Other	-	310	258	.8
Total	-	1,070	914	.9
Total herbicides	-	8,369	6,025	.7
INSECTICIDES				
<u>Single materials</u>				
Acephate	138	138	58	.4
Methomyl	279	314	170	.5
Other	-	207	59	.3
Total	-	659	287	.4
<u>Tank-mix materials</u>				
EPN + methyl parathion	172	207	194+194	.9+ .9
Other	-	34	34+34	1.0+1.0
Total	-	241	456	1.9
Total insecticides	-	900	743	.8
FUNGICIDES				
Benomyl	138	172	50	.3
Other	-	69	18	.3
Total	-	241	68	.3
TOTAL PESTICIDES	-	9,510	6,836	.7

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides, insecticides, and fungicides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

rates for insecticides, applied alone and in mixes, averaged 0.4 and 1.9 pounds (a.i.) per acre-treatment, respectively. Fungicide rates averaged 0.3 pound (a.i.) per acre-treatment.

Of the 9.5 million pesticide acre-treatments, 7.3 million were single material herbicides, 1.1 million were herbicide mixes, 659,000 were single material insecticides, 241,000 were insecticide mixes, and 241,000 were fungicides.

More than one-third (2.5 million) of the single material herbicide acre-treatments were trifluralin, while 40 percent were made with either bentazon (1.5 million) or metribuzin (1.4 million). Dinoseb plus naptalam accounted for 279,000 (26 percent) of the herbicide mix acre-treatments. Metribuzin plus trifluralin acre-treatments totaled 172,000 (16 percent). Crabgrass, cocklebur, and pigweed control accounted for 70 percent of the alachlor acre-treatments (Appendix Tables 2 and 3). About 87 percent of the bentazon acre-treatments were made for cocklebur control. One-third of the metribuzin acre-treatments were made to control cocklebur infestations and one-fourth were made for morningglory control. About 31 and 51 percent of the trifluralin acre-treatments were made to suppress crabgrass and Johnsongrass infestations, respectively.

About 314,000 (48 percent) of the single material insecticide acre-treatments were methomyl and one-fifth (138,000) were acephate (Table 10). Approximately 86 percent (207,000) of the insecticide mix acre-treatments were EPN plus methyl parathion. Corn earworm control accounted for 44 percent of the methomyl acre-treatments, while 23 and 22 percent, respectively, were made to suppress armyworm and cabbage looper infestations (Appendix Table 4).

Benomyl accounted for 172,000 (71 percent) of the fungicide acre-treatments (Table 10). Six-tenths of the benomyl acre-treatments were made to control leaf blight, while 40 percent were made for anthracnose and leaf spot control (Appendix Table 5).

TENNESSEE

During the 1980 growing season, 2.7 million acres of soybeans were planted in Tennessee, of which 2.5 million were treated with herbicides, 130,000 were treated with insecticides, 33,000 were treated with nematicides, and 65,000 were treated with fungicides (Table 2). About 4.7 million pounds (a.i.) of pesticides were applied to soybeans, consisting of 3.5 million pounds of single material herbicides, 922,000 pounds of herbicide mixes, 213,000 pounds of insecticides, 33,000 pounds of nematicides, and 28,000 pounds of fungicides (Table 11). Application rates for herbicides, applied alone and in mixes, were 0.8 and 1.3 pounds (a.i.) per acre-treatment, respectively. Insecticides were applied at an average rate of 1.6 pounds (a.i.) per acre-treatment. Nematicide and fungicide rates averaged 1.0 and 0.4 pound (a.i.) per acre-treatment, respectively.

Farmers made 5.4 million pesticide acre-treatments, comprised of 4.5 million with single material herbicides, 650,000 with herbicide mixes, 131,000 with insecticides, 33,000 with nematicides, and 66,000 with fungicides.

One-third (1.5 million) of the single material herbicide acre-treatments were bentazon and another third were trifluralin. Dinoseb plus naptalam accounted for 196,000 (32 percent) of the herbicide mix acre-treatments, while bentazon plus 2,4-DB and metribuzin plus trifluralin acre-treatments each totaled 131,000 (21 percent). Nearly one-half of the herbicide acre-treatments were made to control cocklebur infestations in Tennessee compared with 33 percent for the region (Table 3). Approximately 40 percent of the alachlor acre-treatments were made for crabgrass control, while foxtail and Johnsongrass control each accounted for 20 percent (Appendix Table 2). Trifluralin acre-treatments totaled 48 and 41 percent, respectively, for crabgrass and Johnsongrass control.

Table 11. Usage patterns and quantities of specific pesticides applied to soybeans in Tennessee, 1980 a/

Pesticides	: Acres <u>b/</u>	: Acre- <u>c/</u>	: Pounds of active ingredient	
	: treated	: treatments	: Total	: Per treatment
----- <u>Thousand</u> -----				
HERBICIDES				
Single materials				
Alachlor	164	164	392	2.4
Bentazon	1,439	1,522	1,033	.7
Fluchloralin	294	294	245	.8
Glyphosate	361	383	104	.3
Linuron	229	229	152	.7
Metribuzin	131	131	95	.7
Trifluralin	1,452	1,468	1,301	.9
Other	-	294	195	.7
Total	-	4,485	3,517	.8
Tank-mix materials				
Bentazon + 2,4-DB	131	131	65+5	.5+ .04
Dinoseb + naptalam	164	196	102+194	.5+1.0
Metribuzin + trifluralin	131	131	91+115	.7+ .9
Other	-	192	350	1.9
Total	-	650	922	1.3
Total herbicides	-	5,135	4,439	.9
INSECTICIDES				
Methyl parathion + toxaphene	98	98	67+135	.7+1.4
Other	-	33	11	.4
Total	-	131	213	1.6
NEMATICIDES				
Total <u>d/</u>	-	33	33	1.0
FUNGICIDES				
Total <u>d/</u>	-	66	28	0.4
TOTAL PESTICIDES	-	5,365	4,713	.9

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Most farmers applied herbicides, insecticides, nematocides, and fungicides one time during the growing season. The average number of applications per season for each material can be determined by dividing acre-treatments (column 2) by acres treated (column 1).

d/ Specific materials not reported because of a limited number of observations.

All of the bentazon and metribuzin was used to control cocklebur infestations (Appendix Table 3).

Three-fourths (98,000) of the insecticide acre-treatments were methyl parathion plus toxaphene (Table 11). Farmers reported that 75 percent of the insecticide acre-treatments were made for corn earworm control as compared with 16 percent for the region (Table 4).

Nematicide and fungicide acre-treatments totaled 33,000 and 66,000, respectively (Table 11). Brown spot was the primary target disease for all of the fungicide acre-treatments (Table 5).

REFERENCES

1. Delvo, Herman W., "1972 Soybean Objective Yield Survey", USDA, ERS, Farm Production Economics Division, 1972, (unpublished).
2. U.S. Department of Agriculture, "Agricultural Statistics, 1974".
3. USDA, ESS, Crop Reporting Board, "Crop Production-1980 Annual Summary", CrPr 2-1(81), January 14, 1981.
4. USDA, ESS, Crop Reporting Board, "Field Crops-Production, Disposition, Value 1979-80", CrPr 1(81), April 1981.

Appendix Table 1. Coefficients of variation for acres of soybeans treated with specific pesticides in the Mississippi Valley, 1980 a/ b/

Pesticides	:	:	:	:	:	:
	:Arkansas	:Kentucky	:Louisiana	:Mississippi	:Tennessee	:Region
	----- Percent -----					
HERBICIDES						
Single materials						
Alachlor	31	19	19	30	44	11
Bentazon	11	19	41	13	10	6
Fluchloralin	29	61	70	29	32	16
Glyphosate	57	27	<u>c/</u>	57	28	18
Linuron	70	34	<u>41</u>	57	36	20
Metribuzin	32	19	15	13	49	8
Pendimethalin	40	-	35	30	<u>c/</u>	19
Trifluralin	8	15	16	7	<u>10</u>	4
Tank-mix materials						
Acifluorfen						
+ bentazon	<u>c/</u>	-	44	57	-	33
Alachlor						
+ metribuzin	-	-	49	70	<u>c/</u>	37
Bentazon						
+ 2,4-DB	<u>c/</u>	60	-	70	49	32
Dinoseb						
+ naptalam	42	37	-	39	40	20
Metribuzin						
+ trifluralin	<u>c/</u>	70	-	44	49	29
INSECTICIDES						
Single materials						
Carbaryl	70	<u>c/</u>	44	-	-	35
Methomyl	58	-	57	32	<u>c/</u>	24
Methyl parathion	<u>c/</u>	-	24	-	-	23
Tank-mix materials						
EPN						
+ methyl parathion	-	-	44	44	-	31
Methyl parathion						
+ toxaphene	-	-	44	<u>c/</u>	57	33
FUNGICIDES						
Benomyl	-	-	37	49	-	29
Captan	<u>c/</u>	-	-	57	<u>c/</u>	45
PCNB + etridiazole	<u>c/</u>	-	-	<u>c/</u>	<u>c/</u>	58

- None reported.

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ A coefficient of variation is the standard error of the estimate divided by acres treated times 100. A coefficient of variation describes the relative variation of the estimate. The lower the value of the coefficient, the more reliable the estimate.

c/ Use of this material at the State level was not significant and was reported in the "other" or "total" category.

Appendix Table 2. Percentage of soybean herbicide acre-treatments by primary grasses controlled as reported by farmers in the Mississippi Valley, 1980 a/

Herbicides, grasses	: :Arkansas	: :Kentucky	:Loui- :siana	:Missis- :sippi	: :Tennessee	: :Region
	----- Percent -----					
<u>Alachlor</u>						
Barnyardgrass	10	-	18	-	-	9
Broadleaf signalgrass	8	-	14	-	-	7
Crabgrass	41	20	23	20	40	26
Foxtail	21	29	-	-	20	11
Johnsongrass	-	10	5	10	20	7
Other	20	14	13	10	-	13
<u>Bentazon</u>						
Barnyardgrass	-	5	-	-	-	1
Foxtail	-	5	-	-	-	1
Johnsongrass	-	-	-	7	-	2
Other	-	6	-	2	-	-
<u>Metribuzin</u>						
Barnyardgrass	-	-	4	-	-	1
Broadleaf signalgrass	-	-	10	2	-	4
Crabgrass	19	6	10	-	-	6
Foxtail	-	5	-	-	-	1
Johnsongrass	-	15	10	2	-	6
Quackgrass	-	9	-	-	-	1
Other	30	6	17	-	-	10
<u>Trifluralin</u>						
Barnyardgrass	10	4	4	-	-	4
Broadleaf signalgrass	9	-	-	-	-	3
Crabgrass	37	-	15	31	48	32
Foxtail	1	28	-	-	-	3
Johnsongrass	32	46	60	51	41	44
Shattercane	3	-	-	-	-	1
Other	5	3	7	7	7	3

- None reported.

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Appendix Table 3. Percentage of soybean herbicide acre-treatments by primary broadleaf weeds controlled as reported by farmers in the Mississippi Valley, 1980 ^{a/}

Herbicides, broadleaf weeds	:	:	:	:	:	:
	:Arkansas	:Kentucky	:Louisiana	:Mississippi	:Tennessee	:Region
	<hr/> ----- Percent ----- <hr/>					
<u>Alachlor</u>						
Cocklebur	-	8	9	20	-	8
Morningglory	-	14	-	10	-	5
Pigweed	-	-	5	30	-	7
Ragweed	-	5	-	-	20	3
Wild cucumber	-	-	5	-	-	2
Other	-	-	8	-	-	2
<u>Bentazon</u>						
Cocklebur	96	69	82	87	100	92
Morningglory	4	-	18	4	-	3
Ragweed	-	15	-	-	-	1
<u>Metribuzin</u>						
Cocklebur	41	49	22	34	100	35
Morningglory	10	5	3	25	-	13
Pigweed	-	-	14	5	-	6
Ragweed	-	5	-	3	-	2
Sicklepod	-	-	-	12	-	5
Other	-	-	10	17	-	10
<u>Trifluralin</u>						
Cocklebur	3	12	7	7	4	6
Morningglory	-	4	4	-	-	1
Pigweed	-	-	3	-	-	1
Sicklepod	-	-	-	3	-	1
Other	-	3	-	1	-	1

- None reported.

^{a/} "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Appendix Table 4. Percentage of soybean insecticide acre-treatments by primary insects controlled as reported by farmers in the Mississippi Valley, 1980 a/

Insecticides, insects	:	:	:	:	:	:
	:Arkansas	:Kentucky	:Louisiana	:Mississippi	:Tennessee	:Region
	<u>Percent</u>					
<u>Carbaryl</u>						
Armyworm	100	100	83	-	-	87
Velvetbean caterpillar	-	-	17	-	-	13
<u>Methomyl</u>						
Armyworm	-	-	100	23	-	36
Cabbage looper	-	-	-	22	-	13
Corn earworm	44	-	-	44	100	38
Grasshopper	-	-	-	11	-	7
Other	56	-	-	-	-	6
<u>Methyl parathion</u>						
Armyworm	100	-	5	-	-	10
Bean leaf beetle	-	-	6	-	-	5
Cabbage looper	-	-	11	-	-	11
Cutworm	-	-	6	-	-	5
Threecornered alfalfa hopper	-	-	11	-	-	11
Velvetbean caterpillar	-	-	33	-	-	32
Other	-	-	28	-	-	26

- None reported.

a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

Appendix Table Percentage of soybean fungicide acre-treatments by primary diseases controlled as reported by farmers in the Mississippi Valley, 1980 a/ b/

Fungicides, diseases	:Arkansas:	Louisiana:	Mississippi:	Tennessee:	Region
	<u>Percent</u>				
<u>Benomyl</u>					
Anthracnose	-	-	20	-	7
Leaf blight	-	11	60	-	27
Leaf spot	-	-	20	-	7
Pod and stem blight	-	89	-	-	59
<u>Captan</u>					
Brown spot	-	-	-	100	48
Root rot	100	-	-	-	52
<u>PCNB + etridiazole</u>					
Brown spot	100	-	100	100	100

- None reported.

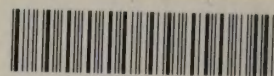
a/ "1980 Soybean Pesticide Use Survey", USDA, ESS, Natural Resource Economics Division.

b/ Fungicide use was not reported in Kentucky for 1980.



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